WHAT IS CLAIMED IS:

1. An exhaust gas purifying system comprising:

a NOx treating catalyst for reducing NOx disposed in an exhaust gas passageway of a combustion device, to reduce NOx in presence of reducing components in exhaust gas; and

a hydrogen enriching device disposed upstream of said NOx treating catalyst with respect to flow of exhaust gas from the combustion device and arranged to increase a ratio of hydrogen to total reducing components in at least one of combustion gas and exhaust gas so as to meet relations represented by following formulae (1) and (2), when reduction of NOx is carried out by said NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad ...(1)$$

$$[H2 / TR]d \geq 0.3 \quad ...(2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in at least one of exhaust gas in the exhaust gas passageway upstream of said hydrogen enriching device and combustion gas in a state before undergoing the hydrogen ratio increasing by said hydrogen enriching means; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and downstream of said hydrogen enriching device.

2. An exhaust gas purifying system as claimed in Claim 1, wherein said hydrogen enriching device is arranged to increase a ratio of hydrogen to carbon monoxide in the total reducing components in exhaust gas so as to meet a relation represented by the following formula $[H2 / CO]d > 1$ where [H2 / CO]d is a ratio between a concentration [H2]d of hydrogen and a concentration [CO]d of carbon monoxide in the total reducing components in exhaust gas in the exhaust gas passageway immediately upstream of

the NOx treating catalyst and downstream of said hydrogen enriching device, when reduction of NOx is carried out by said NOx treating catalyst.

3. An exhaust gas purifying system as claimed in Claim 1, wherein said hydrogen enriching device is at least one selected from the group consisting of a device for producing hydrogen in at least one of combustion gas and exhaust gas, a device for decreasing the reducing components other than hydrogen in at least one of combustion gas and exhaust gas, a device for suppressing consumption of hydrogen in at least one of combustion gas and exhaust gas, and a device for introducing hydrogen into at least one of combustion gas and exhaust gas.

4. An exhaust gas purifying system as claimed in Claim 3, wherein the device for producing hydrogen in at least one of combustion gas and exhaust gas includes at least one selected from the group consisting of a hydrogen producing catalyst containing at least one noble metal, and a combustion control device for controlling at least one selected from the group consisting of operating parameters of an internal combustion engine and combinations of the operating parameters, the operating parameters including fuel injection timing, spark timing, opening and closing timings of intake and exhaust valves of the internal combustion engine.

5. An exhaust gas purifying system as claimed in Claim 3, wherein the device for decreasing the reducing components other than hydrogen in at least one of combustion gas and exhaust gas includes a CO and HC selective oxidation catalyst containing zirconium oxide, for selectively oxidize CO and HC.

6. An exhaust gas purifying system as claimed in Claim 3, wherein the device for suppressing consumption of hydrogen in at least one of combustion gas and exhaust gas is a catalyst containing solid acidic zirconium oxide.

7. An exhaust gas purifying system as claimed in Claim 3, wherein the device for introducing hydrogen into at least one of combustion gas and exhaust gas is a device for supplying hydrogen-contained gas produced by using hydrocarbon fuel and air, from outside of the exhaust passageway.

8. An exhaust gas purifying system as claimed in Claim 7, wherein the device for supplying hydrogen-contained gas includes a hydrogen-contained gas producing catalyst for promoting reaction for producing hydrogen-contained gas from the hydrocarbon fuel, and a device for supplying the hydrocarbon fuel and air to the catalyst.

9. An exhaust gas purifying system as claimed in Claim 8, wherein the hydrogen-contained gas supply device further includes an oxygen concentration sensor disposed upstream of the hydrogen-contained gas producing catalyst so as to detect a concentration of oxygen, and a temperature sensor disposed downstream of the hydrogen-contained gas producing catalyst so as to detect a temperature of the hydrogen-contained gas producing catalyst, wherein amounts of hydrocarbon fuel and air to be supplied to the hydrogen-contained gas producing catalyst are controlled in accordance with the temperature of the hydrogen-contained gas producing catalyst.

10. An exhaust gas purifying system as claimed in Claim 8, wherein the hydrogen-contained gas supply device includes a device for decreasing the amount of hydrocarbon fuel to be supplied and

increasing the amount of air to be supplied so as to increase a concentration of oxygen, when the temperature of the hydrogen-contained gas producing catalyst is lower than a level.

11. An exhaust gas purifying system as claimed in Claim 7, wherein the hydrogen-contained gas supply device includes a device for producing hydrogen-contained gas by using hydrocarbon fuel and exhaust gas under heat.

12. An exhaust gas purifying system as claimed Claim 7, wherein the hydrogen-contained gas supply device includes a device for temporarily storing hydrogen-contained gas which has been produced, before being supplied to said NOx treating catalyst.

13. An exhaust gas purifying system of a multiple step control type in combination with an internal combustion engine having an exhaust gas passageway,

said engine includes a combustion system having a combustion control device for controlling at least one selected from the group consisting of operating parameters of the engine and combinations of the operating parameters, the operating parameters including fuel injection timing, spark timing, opening and closing timings of intake and exhaust valves of the engine;

said exhaust gas purifying system including

a NOx treating catalyst for reducing NOx disposed in the exhaust gas passageway to reduce NOx in presence of reducing components in exhaust gas, and

a hydrogen enriching device disposed upstream of said NOx treating catalyst with respect to flow of exhaust gas and including at least one selected from the group consisting of a hydrogen producing catalyst containing at least one noble metal, a CO and HC selective oxidation catalyst containing zirconium oxide, a catalyst containing solid acidic zirconium oxide, and a device for

supplying hydrogen-contained gas produced by using hydrocarbon fuel and air, from outside of the exhaust passageway, said hydrogen-contained gas supplying device including at least one of a first hydrogen-contained gas supplying device having a hydrogen-contained gas producing catalyst for promoting reaction for producing hydrogen-contained gas from the hydrocarbon fuel, and a device for supplying the hydrocarbon fuel and air to the catalyst, and a second hydrogen-contained gas supplying device for producing hydrogen-contained gas by using hydrocarbon fuel and exhaust gas under heat,

said hydrogen enriching device being arranged to increase a ratio of hydrogen to total reducing components in at least one of combustion gas and exhaust gas so as to relations represented by the following formulae (1) and (2), when reduction of NOx is carried out by said NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad ...(1)$$

$$[H2 / TR]d \geq 0.3 \quad ...(2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in at least one of exhaust gas in the exhaust gas passageway upstream of said hydrogen enriching device and combustion gas in a state before undergoing the hydrogen ratio increasing by said hydrogen enriching means; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and downstream of said hydrogen enriching device.

14. An exhaust gas purifying system as claimed in Claim 13, wherein said hydrogen enriching device is arranged to increase a ratio of hydrogen to carbon monoxide in the total reducing components in exhaust gas so as to meet a relation represented by the following formula of [H2 / CO]d > 1 where [H2 / CO]d is a ratio

between a concentration [H2]d of hydrogen and a concentration [CO]d of carbon monoxide in the total reducing components in exhaust gas in the exhaust gas passageway immediately upstream of the NOx treating catalyst and downstream of said hydrogen enriching device, when reduction of NOx is carried out by said NOx treating catalyst.

15. An exhaust gas purifying system as claimed in Claim 5, wherein the CO and HC selective oxidation catalyst has a function of producing hydrogen and contains rhodium and zirconium oxide, the zirconium oxide containing alkaline earth metal and having a composition represented by the following general formula (3):

$$[X]_aZr_bO_c \quad \ldots (3)$$

where X is an alkaline earth metal selected from the group consisting of magnesium, calcium, strontium and barium; a and b are ratios of atoms of elements; and c is a number of oxygen atoms required for satisfying valences of X and Zr, in which a is within a range of from 0.01 to 0.5, b is within a range of from 0.5 to 0.99, and $a + b = 1.0$.

16. An exhaust gas purifying system as claimed in Claim 15, wherein the CO and HC selective catalyst further contains palladium and cerium oxide, the palladium being carried in an amount ranging from 20 to 80 % by weight of total palladium on cerium oxide.

17. An exhaust gas purifying system as claimed in Claim 6, wherein the catalyst containing solid acidic zirconium oxide contains platinum, the solid acidic zirconium oxide containing at least one element selected from the group consisting of titanium, aluminum tungsten, molybdenum and zinc, the solid acidic zirconium oxide having a composition represented by the following general formula (4):

[Y]dZreOf ... (4)

where Y is at least one element selected from the group consisting of titanium, aluminum, tungsten, molybdenum and zinc; d and e are ratios of atoms of elements; and f is a number of oxygen atoms required for satisfying valences of Y and Zr, in which d is within a range of from 0.01 to 0.5, e is within a range of from 0.5 to 0.99, and d+e = 1.0.

18. An exhaust gas purifying system as claimed in Claim 4, wherein the hydrogen producing catalyst has a function to produce hydrogen from HC and CO in at least one of combustion gas and exhaust gas.

19. An exhaust gas purifying system as claimed in Claim 18, wherein the hydrogen producing catalyst includes a first catalytic component for oxidizing HC and CO to decrease oxygen, said first catalytic component being disposed in a first section of the hydrogen producing catalyst, and a second catalytic component for producing hydrogen and disposed in a second section of the hydrogen producing catalyst, the second section being located downstream of the first section with respect to flow of exhaust gas, so that an amount of oxygen to be contacted with the second catalytic component is decreased.

20. An exhaust gas purifying system as claimed in Claim 19, wherein the first catalytic component includes at least one of palladium and platinum and alumina, at least one of palladium and platinum being contained in an amount ranging from 0.1 to 50 g per one liter of a carrier.

21. An exhaust gas purifying system as claimed in Claim 19, wherein the second catalytic component includes rhodium and zirconium oxide, rhodium being contained in an amount ranging

from 0.1 to 50 g per one litter of a carrier, zirconium oxide being contained in an amount ranging from 10 to 300 g per one liter of the carrier.

22. An exhaust gas purifying system as claimed in Claim 21, wherein the zirconium oxide contains alkaline earth metal and has a composition represented by the following general formula (3):

$$[X]aZrbOc \quad \ldots (3)$$

where X is an alkaline earth metal selected from the group consisting of magnesium, calcium, strontium and barium; a and b are ratios of atoms of elements; and c is a number of oxygen atoms required for satisfying valences of X and Zr, in which a is within a range of from 0.01 to 0.5, b is within a range of from 0.5 to 0.99, and $a + b = 1.0$.

23. An exhaust gas purifying system as claimed in Claim 18, further comprising a device for controlling exhaust gas a position upstream of the hydrogen producing catalyst to intermittently have a composition in which air-fuel ratio is rich, so as to raise efficiency of production of hydrogen by the hydrogen producing catalyst.

24. An exhaust gas purifying system as claimed in Claim 1, wherein said NOx treating catalyst contains at least one noble metal selected from the group consisting of platinum, palladium and rhodium, and at least one substance selected from the group consisting of alumina, alkali metal and alkaline earth metal.

25. An exhaust gas purifying system as claimed Claim 1, wherein said NOx treating catalyst contains at least rhodium and arranged to be capable of reducing NOx in exhaust gas at a temperature ranging from 260 to 380 °C.

26. An exhaust gas purifying system as claimed in Claim 1, wherein said combustion device is an internal combustion engine.

27. An exhaust gas purifying system as claimed in Claim 1, wherein the internal combustion engine is a gasoline-fueled engine for an automotive vehicle.

28. An exhaust gas purifying system comprising:

a NOx treating catalyst for reducing NOx disposed in an exhaust gas passageway of a combustion device, to reduce NOx in presence of reducing components in exhaust gas; and

means for enriching hydrogen disposed upstream of said NOx treating catalyst with respect to flow of exhaust gas from the combustion device, said hydrogen enriching means is for increasing a ratio of hydrogen to total reducing components in at least one of combustion gas and exhaust gas so as to meet relations represented by the following formulae (1) and (2), when reduction of NOx is carried out by said NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad ...(1)$$

$$[H2 / TR]d \geq 0.3 \quad ...(2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in at least one of exhaust gas in the exhaust gas passageway upstream of said hydrogen enriching device and combustion gas in a state before undergoing the hydrogen ratio increasing by said hydrogen enriching means; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and downstream of said hydrogen enriching device.

29. A method of purifying exhaust gas from a combustion device provided with an exhaust gas purifying system including a

NOx treating disposed in an exhaust gas passageway of the combustion device, the NOx treating catalyst reducing NOx in presence of reducing components in exhaust gas, said method comprising:

increasing a ratio of hydrogen to total reducing components in at least one of combustion gas and exhaust gas to be supplied to the NOx treating catalyst so as to meet relations represented by the following formulae (1) and (2), when reduction of NOx is carried out by said NOx treating catalyst:

$$[H2 / TR]d > [H2 / TR]u \quad ...(1)$$

$$[H2 / TR]d \geq 0.3 \quad ...(2)$$

where [H2 / TR]u is a ratio between a concentration [H2]u of hydrogen and a concentration [TR]u of total reducing components in at least one of exhaust gas in the exhaust gas passageway upstream of said hydrogen enriching device and combustion gas in a state before undergoing the hydrogen ratio increasing; and [H2 / TR]d is a ratio between a concentration [H2]d of hydrogen and a concentration [TR]d of total reducing components in exhaust gas in the exhaust gas passageway upstream of the NOx treating catalyst and in a state after undergoing the hydrogen ratio increasing.